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भारतीय मानक

# कोयला आदग्ध मजबूती के निर्धारण की प्रणाली

Indian Standard

# METHOD OF DETERMINATION FOR COAL CHAR STRENGTH

ICS 75.160.10

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**BUREAU OF INDIAN STANDARDS**
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

*October* 2001 **Price Group 2**

Sponge Iron and Smelting Reduction Sectional Committee, MTD 30

## FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Sponge Iron and Smelting Reduction Sectional Committee had been approved by the Metallurgical Engineering Division Council.

The degradation of char in kiln depends on the coal char strength, the carbon loss in flue dust will be high if the char strength is low. Therefore, the char strength should be high. Test sample of different collieries which are used at OSIL for production of DRI has been subjected to the test described in standard. The results obtained are given in Annex A for information.

Char strength has not yet been standardized under Indian conditions. Experiments in this regard are going on in OSIL Lab. DRC has developed a test for specifying char strength which is given below:

The test involves preparing 200 g of 10-25 mm size char, agitating for a fixed number of revolutions in a micro-tumbler and sieving the production for a given period on a ro-tap sieve shaker. The amount of 40 mesh retained is taken as a measure of char strength.

Results of the test are simulated with performance of the kiln and strength recommended on the performance value.

The composition of the committee responsible for formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard*

# METHOD OF DETERMINATION FOR COAL CHAR STRENGTH

## 1 SCOPE

This standard prescribes the method of determination of coal char strength which is one of the vital parameters for determination of the suitability of the coal for production of sponge iron in Rotary Kiln based processes.

## 2 REFERENCE

The following standard contains provisions which through reference in this text, constitutes provision of this standard. At the time of publication, the edition was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

| *IS No.* | *Title* |
|---|---|
| 460 | Test sieves (in various parts) |

## 3 PRINCIPLE OF TEST

The test consists of placing the test sample in a standard tumbler drum and rotating it after tightly closing the door. After the specified number of revolutions, the sample is removed and screened by means of a standard 6.3 mm IS sieve. The fraction retained on 6.3 mm sieve is calculated.

## 4 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

### 4.1 Coal Char Strength

It is a relative measure of the resistance of the materials to breakage or degradation by impact and abrasion.

## 5 TEST SAMPLE

### 5.1 Preparation of Coal Char

For this purpose a muffle furnace suitable to maintained a temperature of 900 to 1 000°C is required. Coal samples of about 30 mm size are taken in a heat resisting SS Tube (S.S. 310) to which arrangement to pass Nitrogen gas and to drive off volatiles should be provided. The dimension of the coal char preparation container is as follows:

> About 200 g of coal is taken in the container. Nitrogen gas is connected to it and passed at a speed of 10-15 l/min. The container in the muffle furnace is maintained at 900 ± 20°C. Volatiles from coal starts coming out which is burnt outside. The stoppage of burning of volatile matter ensures removal of volatile from coal. Continue heating and passing of nitrogen gas for further 5 min to ensure complete removal of volatiles. Remove the container from the furnace, while Nitrogen is passed. Allow the container to cool to room temperature in an atmosphere of Nitrogen. Stop passing Nitrogen gas, remove the coal char. Repeat preparation of char till about 1.2 kg of char is obtained.

### 5.2 Sample Size

Crush the coal char sample manually, sieve and separate size fractions between 10 to 25 mm for the test.

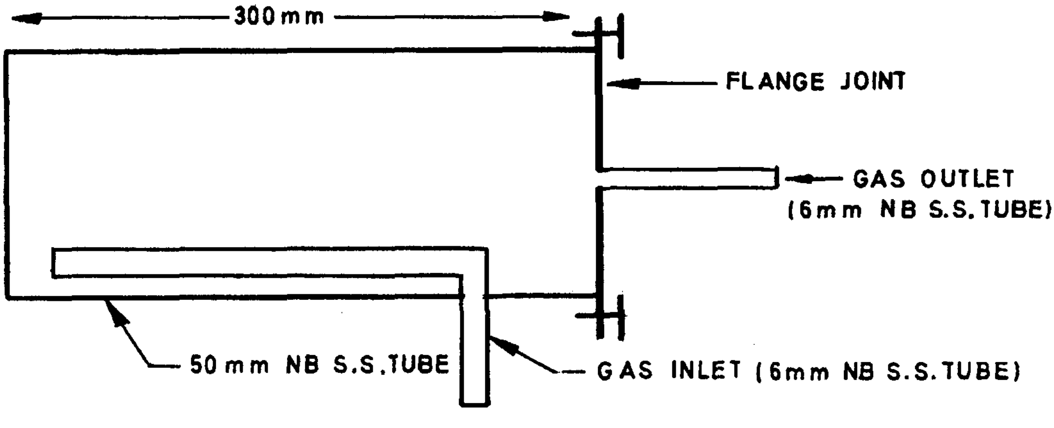

FIG. 1 COAL CHAR PREPARATION CONTAINER

### 5.3 Quantity of Sample

Prepare 200 g of the samples for each test 4 number of samples are required to complete one set of test.

## 6 TEST APPARATUS

### 6.1 Tumbler Rotating Drum

It shall consist of a circular drum of 200 mm inside diameter and 200 mm inside length and shall be constructed of steel plate at least 3 mm in thickness. The drum shall be replaced whenever the thickness of the plate is reduced by wear to 2 mm in any area. The door shall be so constructed as to fit into the drum to form a smooth continuous inner surface with the shell of the drum without having any gap between them and during the test shall be rigidity fastened to prevent loss of the sample. The apparatus shall be fitted with a revolution counter. The apparatus shall be powered with a minimum 0.75 kW so as to ensure that the drum attains full uniform speed in one revolution, rotates uniformly, and stops within one revolution.

### 6.2 Sieves

Square mesh sieves or plates having the following sizes shall be used 25 mm, 10 mm and 6.3 mm.

**6.2.1** The sieves shall conform to IS 460 (in various parts).

### 6.3 Scales

The weighing scale should be of a capacity of 500 g with a sensitivity of 0.01g or better.

## 7 TEST PROCEDURE

The test sample shall be placed into the tumbler drum and the door fastened tightly. The drum shall be rotated at 30 ± 1 rev/min for a total of 210 revolutions. All the material shall then be gently removed from the drum and sieved on 6.3 mm IS sieve. The mass of the part of the sample retained on the 6.3 mm IS sieve shall be determined.

## 8 RECORD

The sieve analysis after the test shall be reported to the nearest 0.11 percent, as the percent retained on the 6.3 mm IS sieve.

## 9 CALCULATION

**9.1** The coal char strength shall be calculated to the second decimal by rounding off the third decimal in accordance with the following formula:

$$\text{Coal Char Strength} = \frac{B}{B+C} \times 100$$

where

$B$ = mass in g of the sample part retained on the 6.3 mm IS sieve, and

$C$ = mass in g of the sample part passing the 6.3 mm IS Sieve.

## 10 NUMBER OF TESTS AND PERMISSIBLE TOLERANCES

**10.1** A duplicate test shall be made on each sample. If the difference between the paired values falls within the permissible tolerance given in **10.2** the mean value shall be reported.

**10.2** A tolerance limit of 1 percent is allowed between test to test. If the difference between the first paired value exceeds 1 percent another duplicate test shall be made. If neither duplicate test conforms to the permissible tolerance, all values shall be individually reported and the four values shall be averaged.

### 10.3 Permissible Weight Loss

The difference between the initial weight of the sample and the total of the fraction weights shall not exceed 1.0 percent of the initial sample weight. If this difference exceeds 1.0 percent the test shall be rejected.

## ANNEX A

### ( *Foreword* )

### CHAR STRENGTH OF TEST SAMPLES PERTAINING TO DIFFERENT COLLERIES USED AT ORISSA SPONGE IRON LTD, KEONJHAR

Test sample of different colleries which are used at OSIL for production of DRI has been subjected to the test described above. The results are as follows:

| *Sample* | *Coal Char Strength*, percent |
|---|---|
| 1 | 97.35 |
| 2 | 97.82 |
| 3 | 97.10 |
| 4 | 97.37 |
| 5 | 97.13 |
| 6 | 97.11 |
| 7 | 96.85 |
| 8 | 96.55 |
| 9 | 97.31 |
| 10 | 96.64 |

## ANNEX B

### ( *Foreword* )

### COMMITTEE COMPOSITION

Sponge Iron & Smelting Reduction Sectional Committee, MTD 30

| *Organization* | *Representative(s)* |
|---|---|
| Tata Iron & Steel Co Ltd, Jamshedpur | Dr Amit Chatterjee (*Chairman*) |
| Central Fuel Research Institute, Dhanbad | Representative |
| Essar Steels, Mumbai | Shri K. Jyothi |
| Gas Authority of India, New Delhi | Shri R. G. Rajan<br>Shri P. S. Sareen (*Alternate*) |
| GSAL Ltd, Hyderabad | Shri K. P. Patnaik<br>Shri K. S. N. Murthy (*Alternate*) |
| HEG Ltd, Durg | Shri S. N. Mishra |
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| Jindal Steel & Power Ltd, Raigarh | Shri K. C. Thatoi<br>Shri U. Bhattachrjee (*Alternate*) |
| Kudremukh Iron Ore Co Ltd, Chikmaglur | Shri T. R. R. Rao |
| MECON (India) Ltd, Ranchi | Shri P. Bhattacharya<br>Shri A. K. Agrawal (*Alternate*) |
| Ministry of Steel, New Delhi | Shri D. Kashiva<br>Shri S. K. Bhatnagar (*Alternate*) |
| M. N. Dastur & Co (P) Ltd, Kolkata | Shri Adhip Sengupta<br>Ms Aditi Tarafdar (*Alternate*) |
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| Mukand Ltd, Thane | Shri C. H. Sharma |
| National Metallurgical Laboratory, Jamshedpur | Dr Swatantra Prakash |
| National Mineral Development Corporation Ltd, Hyderabad | Representative |
| Nova Iron & Steel Co Ltd, Bilaspur | Shri A. Rajasekaran<br>Shri B. Gopichand (*Alternate*) |
| Orissa Sponge Iron Ltd, Distt Keonjhar | Shri N. K. Patnaik<br>Shri S. C. Jena (*Alternate*) |
| Prakash Industries, New Delhi | Representative |
| Raipur Alloys, Raipur | Shri N. Rath |
| SAIL, R&D Centre, Ranchi | Shri G. I. S. Chauhan<br>Dr K. K. Prasad (*Alternate*) |
| Sponge Iron Manufacturers' Association, New Delhi | Shri S. S. Bhatnagar |
| Sponge Iron India Ltd, Khammam | Shri M. Amareshwar Rao |
| Steel Furnace Association of India, New Delhi | Shri M. S. Unninair |
| Sunflag India Ltd, Bhandara | Shri D. K. Gaur<br>Shri S. P. Dash (*Alternate*) |
| TATA Sponge Iron, Distt Keonjhar | Shri B. M. Sarangi |
| Usha (India) Ltd, New Delhi | Shri B. K. Roy |
| Vikram Ispat, Mumbai | Dr S. K. S.Yadav |
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Shri Ram Awadh Ram
Deputy Director (MTD), BIS

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